SAFETY IN HIGHWALL MINING

1.0 BACKGROUND

Thiess Contractors has a proud record in managing Health, Safety and Environment issues as a wide range of workplaces with diverse disciplines throughout Australia and South-East Asia.

Our Health Safety and Environment Systems have been developed to meet the requirements of AS/N2S 1Z0 9000 - series of Quality Standards and are managed accordingly.

1.1 OCCUPATIONAL HEALTH, SAFETY & ENVIRONMENT MANAGEMENT SYSTEMS

A controlled issue Health, Safety and Environment Management System Manual, setting out policy, objectives and administrative requirements, supported by management system and safe work procedures, is issued to all management staff, in order to produce uniformity, direction and assistance to enable a safe and successful completion of the project.

In order to implement an effective Management System the company document is prepared in a three tier structure to provide flexibility in preparation, approval, issue and use. The tiers are as follows.

- Tier 1 - Occupational Health Safety and Environment Manual

A concise document outlining the structure and general principals of the Health Safety and Environment Management Systems for the Group.

- Tier 2 - System Procedures

These procedures describes how activities within the company are performed. Procedures include what, how, when and where steps are performed and by whom. Where applicable they detail what materials, equipment and documents are used and how they are to be controlled.

- Tier 3 - Health Safety and Environment Plans

For each project a specific Health Safety and Environmental Management Plan is developed by the project team, supported by the Area Safety Manager as a technical resource. The plan details the specific Health safety and Environment Procedures and Safe Work Procedures applicable to the project. These procedures cover Risk Management, Plant Certification, Training, Competency Assessment for Operators, to name but a few.

1.2 AUDITING

To verify that the systems, conditions and equipment are in compliance with regulations and company standards, three monthly audits are conducted by the Area Safety Manager. Audit results are reported to the General Manager and the Managing Director.

1.3 TEAM WORK

We believe that Quality and Safety are inseparable and our people are the key to our success in both areas. Each and every person on the Oaky Creek Project plans an important role in the way we manage Health and Safety.

2.0 INTRODUCTION

This paper examines the occupational hazards and safety implications of the advent of highwall mining in Australia, and the means employed to address these concerns. The focus will be primarily on those hazards which are heightened by, or are unique to highwall mining when contrasted with conventional mining methods and technology.

In summary this paper briefly reviews:

1. Highwall mining equipment and technology
2. Current applications in Australia
3. Hazards and risks associated with highwall mining
4. Strategies and solutions employed to reduce risk and enhance safety.

3.0 EQUIPMENT AND TECHNOLOGY

Highwall mining equipment in general use broadly classifies as one of the two types

- Continuous miner based systems, and
- Augers

Continuous miner based systems developed much later than augering and are considerably more complex and capital intensive. In compensation they offer far superior production and penetration capabilities, although the augers comparative mobility and advantages in certain conditions, ensures a future exists for both technologies in highwall mining.

Several continuous miner based highwall mining systems exist in the United States, in various stages of development. To date however, the only system to operate in Australia is the Continuous Highwall Miner (CHM), such as the one which has been mining at Oaky Creek since July 1993. This machine is leased from Joy Manufacturing by Oaky Creek and operated by Thiess Contractors on a contract mining basis.

The Oaky Creek CHM will be the focus of discussion here, although many of the hazards and safety concerns apply equally to augers, and our experiences augering at South Blackwater and Moura will also be drawn upon.

3.1 THE CONTINUOUS HIGHWALL MINER (CHM)

The key components of the system comprises

- A continuous miner
- A launch vehicle
- Conveyor cars
- A stacker
- Rubber tyred loaders

3.1.1 The Continuous Miner

The continuous miner is a Joy 14CM15 constructed to underground specifications apart from a shortened and fixed tail. Additionally cameras have been fitted to provide the remote operator with instantaneous pictures of the face, machine instrumentation and methane detectors.

3.1.2 The Launch Vehicle

The launch vehicle is the main platform from which the continuous miner and conveyor cars enter the coal seam. A central "belly belt" receives coal from the miner and conveyor cars as added, and transports it to a stacker. Additionally the launch vehicle houses the power centre and operator control centre, plus hydraulic systems to provide thrust force for mining advance and retreat, and machine positioning.

3.1.3 Conveyor Cars

Wheel mounted conveyor cars, known as Addcars, 12.6m in length, are added as the continuous miner advances under the highwall. Each car is powered by a 22KW, 1000V motor, and has a small take up roller to tension its 1.2m wide belt.

3.1.4 Stacker

The stacker accepts coal from the launch vehicle belly belt and can either discharge into trucks directly or stockpile coal to a height of 5.0m. The 1.4m wide stacker belt is designed for 1000 tph capacity.

3.1.5 Loaders

Thiess employs two 988 Cat Loaders whose task is the loading and unloading of conveyor cars, and the stockpiling of coal in pit for later removal by the client. A quick hitch arrangement enables one loader to perform both tasks depending on the mining output.

3.2 THE CHM MINING PROCESS

Mining commences by driving the continuous miner off the launch vehicle platform directly into the coal seam. As mining progresses, cascading conveyor cars are added in a truly continuous process without any requirement to stop mining. The miner and conveyor cars advance with thrust provided by hydraulically powered push arms mounted on the launch vehicle, aiding the tractive effort of the continuous miner.

The system is operated by remote control from a cab at the rear of the launch vehicle. Once the mining entry is complete, the conveyor cars and continuous miner are retracted in a sequence which is just the reverse of the mining advance sequence. Having completed mining and retraction the machine is repositioned for the next drive and the continuous miner serviced. Repositioning occurs via walking skids.

4.0 CURRENT APPLICATIONS AND CAPABILITIES

The CHM was introduced to Australia following several years of prototype development and successful operations in Kentucky, West Virginia and Ohio (USA). During development it demonstrated production capabilities of 1 Mt per annum and penetration depths exceeding 300m.

Following its introduction in mid 1993, production results for the CHM were initially disappointing due to adverse geological conditions encountered, workforce inexperience with the new technology and problems associated with the previous operator. The current arrangement between Oaky Creek and Thiess has proven successful and productivity from the CHM has averaged 20,000 ROM tonnes per week for the past six months.

The CHM is currently highwall mining a final highwall in the German Creek Seam in an area where depth of cover averages 45m and seam thickness is 1.9m. Recent upgrades to the machine have extended the penetration depth capability to 350m.

5.0 HAZARDS AND RISKS ASSOCIATED WITH HIGHWALL MINING

Highwall mining is essentially a hybrid form of mining incorporating elements from both surface and underground mining. The mining method provides exposure to some of the more catastrophic hazards associated with each, and in some instances exacerbates them.

Although all operating personnel are surface located in the pit, coal cutting occurs in an underground environment. Consequently operations are exposed to underground mining risks such as gas emissions and roof collapse. Remotely controlled operating reduces exposure of personnel, but increases the risk to machinery as hazards are more likely to pass undetected.

Highwall mining operations by definition occur at the base of the highwall, a prime safety hazard in all open cut mining operations. This hazard is increased by the undermining of the highwall which alters the stress distribution in the rock mass, with possible unfavourable implications for rock mass integrity.

The above discussion highlights the primary safety hazards which will be examined here in terms of the measures we have adopted to minimise the risks associated with highwall mining, as well as their potential severity. The hazards can be broadly categorised as follows:

- Highwall hazards
- Roof span collapse hazards
- Explosion hazards
- Equipment hazards

6.0 STRATEGIES AND SOLUTIONS

6.1 HIGHWALL HAZARDS

Highwall failures may range from small localised failures resulting in slippage or breakage of small rock fragments, to total highwall collapse due either to pillar crushing or failures associated with insitu structures with a high pre-disposition for toppling or slip failures.

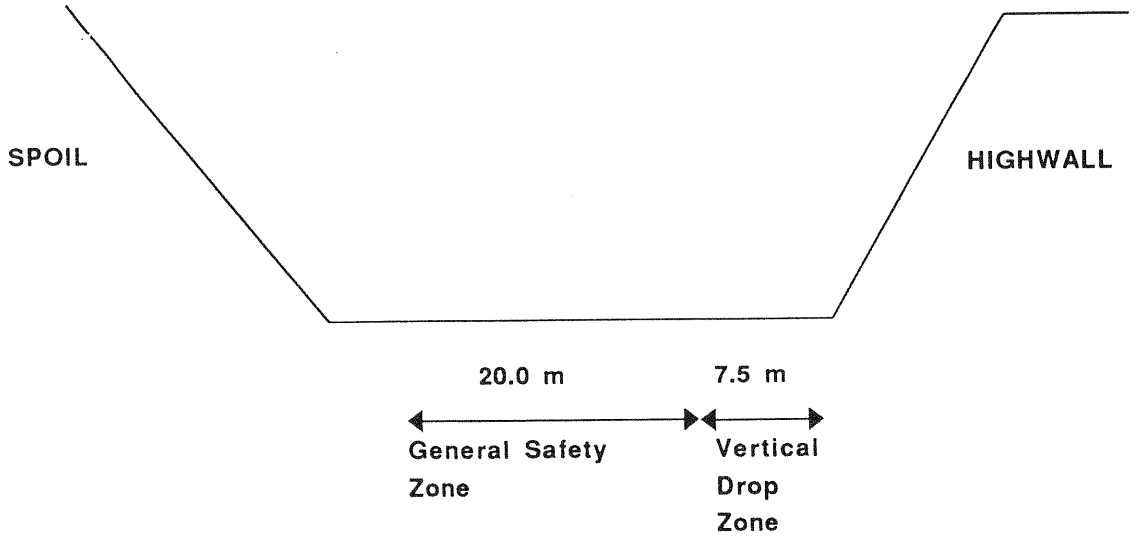
In addressing highwall hazards prevention is the central tenet. In practice this translates into the following approaches.

- Geotechnical design
- Operational procedures
- Machine design features
- Excavation design features

6.1.1 OPERATIONAL PROCEDURES

The risk of injury due to highwall failures can be greatly reduced simply by minimising the hazardous exposure of personnel, to the minimum levels necessary for operation. To ensure this, the following two stage approach has been implemented. Firstly access to the highwall mining pit is restricted to authorised personnel only. Secondly, distinction is drawn in the pit between the vertical drop zone and a general safety zone. The vertical drop zone is the area most falling material will land.

Figure 1. Vertical Drop Zone



It is stressed at both general, and CHM specific inductions to all employees, that the vertical drop zone is particularly dangerous and that the only time personnel should be allowed in this zone is during mining operations and while performing essential duties, eg.clean up of the highwall toe. All other activities eg. general maintenance, crib etc should occur in the general safety zone. No one is to enter the vertical drop zone unless they are protected by Full Overhead Protection and/or have a spotter watching the highwall.

6.2.1 MINIMISING EXPOSURE TIME

The Continuous Highwall Mining System as its name infers, must be operated continuously. The mining system results in the continuous miner progressing 350 metres into an unsupported opening. Successful and safe operations can only be achieved through rapid entry and retraction, otherwise the CHM could readily become buried in rock. In fact the present system has been buried five times, requiring extraction with a block and tackle rescue system.

In reality the CHM has been subjected to hundreds of roof falls however, the CHM has always been manned thus ensuring rapid retraction and subsequent recovery. As experienced miners around the world know only too well, roof falls are time dependant. Any time wasted could result in the initial fall propagating.

Consequently the safe and efficient operation of this technology necessitates the crews to start and finish work on the machine. To leave the CHM unattended for 30 minutes, could result in an unobserved fall and subsequent burial. To retract and re-enter at each shift change would take on average two to three hours and is consequently impractical. Accordingly it is necessary for the full agreed shift length to be spent on the CHM and hence hot seat changes have been in use from day one.

6.2.2 GEOTECHNICAL RESEARCH

Considerable geotechnical studies have been undertaken prior to and during the life of the highwall mining project at Oaky Creek. These range from studies undertaken prior to highwall mining of any area, enabling risk assessment and development of panel designs, to industry funded studies of highwall and trench mining.

Specifically targeting roof span stability, Thiess is currently among contributors to an Australian Coal Association Research Project (ACARP), to be undertaken by CSIRO in conjunction with highwall mining operators.

Thiess is committed to continuing to support geotechnical research, although admittedly with respect to roof fall occurrences, predictability and the development of counter measures; success has so far eluded us.

6.3 EXPLOSION HAZARDS

The actual coal mining process in highwall mining occurs in a totally underground environment with the consequent potential for creation and exposure to atmospheres with methane in the explosive range. This truth was tragically demonstrated in 1992 when an explosion occurred at an eastern USA CHM operation resulting in a fatality. A 1993 U.S. Bureau of Mines publication, further reports recent incidents of methane explosions at augering operations which have resulted in injuries to operating personnel.

To minimise explosion hazards CHM operations comply with all underground mining regulations with respect of flame proof enclosures and/or intrinsic safety of all machinery and instrumentation entering the highwall mining drives.

Methane monitoring occurs continuously at the continuous miner with results displayed in the operator cab, and visual and audible alarms triggered if methane levels of 0.5% are recorded. Although the Oaky Creek operations occur in a low methane environment, compressed air is available for ventilation should methane levels of 0.5% be recorded. Methane level readings

are noted as each Addcar is added and the results are recorded by operators on daily shift reports, along with any observations of frictional sparking.

As a further precautionary measure blast shield doors are fitted at the front of the launch vehicle designed to sustain any methane blasts, and thus protect personnel working on or about the launch vehicle.

With regards to Auger operations Thiess have adopted a leadership role installing and trialing gas inertisation systems on auger operations at South Blackwater and Moura. Gas inertisation systems were developed by Thess. after becoming aware of U.S.B.M. trials.

The gas inertisation system is essentially a burner which burns diesel fuel at about 35 litres per hour generating exhaust fumes which are cooled and piped into the auger entry. The result is an atmosphere in the auger entry containing only 6-8% oxygen and thereby non combustible.

7.0 CONCLUSION

This paper has sought to highlight and address a few of the major safety measures and features applicable for some of the more significant hazards associated with highwall mining. Highwall mining however remains relatively new to Australia and much work remains ahead to further our understanding of the highwall mining environment and thus enable action to further reduce attendant risks, while fully exploiting the technologies attractions.

FOOTNOTE

Thiess would like to acknowledge and congratulate its Oaky Creek Highwall Mining Project employees on their safety performance. Recognition of their efforts was recently achieved at the National Mining and Mineral Industries Excellence awards (Minex 1995) with a Highly Commended Award for health and Safety awarded to the project. To date the project has completed 450 days without any lost time injuries.